

1           1.    A method comprising:  
2                    securing an integrated electroosmotic pump to an  
3 integrated circuit to be cooled; and  
4                    packaging the integrated electroosmotic pump  
5 coupled to an integrated circuit with a re-combiner.

1           2.    The method of claim 1 including forming said  
2 electroosmotic pump in an integrated circuit die, said pump  
3 formed on one side of said die.

1           3.    The method of claim 2 including forming  
2 microchannels to circulate a cooling fluid on the opposite  
3 side of said die, and coupling said opposite of said die to  
4 said integrated circuit to be cooled.

1           4.    The method of claim 1 including stacking a first  
2 die including said integrated electroosmotic pump on a  
3 second die including said integrated circuit to be cooled.

1           5.    The method of claim 4 including forming said  
2 condenser on a third die and stacking said third die on  
3 said first die.

1           6.    The method of claim 5 including mounting a heat  
2 exchanger on said re-combiner.

1           7.    The method of claim 5 including coupling said  
2   first die to said second die using copper-to-copper  
3   bonding.

1           8.    The method of claim 1 including packaging said  
2   integrated electroosmotic pump coupled to said integrated  
3   circuit in a flip-chip package.

1           9.    The method of claim 1 including packaging said  
2   integrated electroosmotic pump coupled to an integrated  
3   circuit with a re-combiner in a bumpless build-up layer  
4   package.

1           10.   A packaged integrated system comprising:  
2                   an integrated circuit;  
3                   an integrated electroosmotic pump mounted on said  
4   integrated circuit;  
5                   a re-combiner; and  
6                   a package including said circuit, said pump, and  
7   said condenser.

1           11.   The system of claim 10 wherein said integrated  
2   circuit is part of a first die and said integrated  
3   electroosmotic pump is part of a second die, said second  
4   die having a first side and a second side, said pump formed  
5   on said first side.

1           12. The system of claim 11 including microchannels to  
2 circuit cooling fluid on said second side and said second  
3 side mounted on said first die.

1           13. The system of claim 11 including stacking said  
2 first die on said second die.

1           14. The system of claim 13 including a third die,  
2 said third die including a re-combiner, said third die  
3 stacked on said first and second dice.

1           15. The system of claim 14 including a heat exchanger  
2 stacked on said re-combiner.

1           16. The system of claim 14 wherein said first die is  
2 coupled to said second die using copper-to-copper bonding.

1           17. The system of claim 10 wherein said package is a  
2 flip-chip package.

1           18. The system of claim 10 wherein said package is a  
2 bumpless build-up layer package.

1        19. A packaged integrated circuit comprising:  
2            an integrated circuit;  
3            an integrated electroosmotic pump;  
4            a combiner; and  
5            a bumpless build-up layer package including said  
6 circuit, said pump, and said combiner, said package  
7 including a build-up layer that mechanically couples said  
8 circuit, said pump, and said combiner.

1        20. The system of claim 19 wherein said integrated  
2 electroosmotic pump is formed on a first die and said  
3 integrated circuit is formed on a second die and said  
4 condenser is formed on a third die.

1        21. The system of claim 20 wherein said integrated  
2 circuit die is mounted on said integrated electroosmotic  
3 pump die.

1        22. The system of claim 21 wherein said first and  
2 second dice are coupled by copper-to-copper bonding.

1        23. The system of claim 19 including a heat spreader  
2 coupled to said build-up layer.

1           24. The system of claim 20 wherein said first die  
2 includes at least one electroosmotic pump on one side and a  
3 plurality of microchannels on the other side, said  
4 microchannels to circulate cooling fluid pumped by said  
5 electroosmotic pump.

1           25. The system of claim 24 wherein said first die is  
2 mounted on said second die with said microchannels facing  
3 said second die.